Nonwovens Processes

Spunbonded and Spunmelt Composites

Description

Spunbonded and spunmelt composites (a combination of spunbonded and melt blown in a multi-layered structure) are nonwoven technologies in which fabrics are produced directly from polymers in a single process. The spunbonded manufacturing process begins with resin chips, which are melted and extruded (spun) into filaments through various processes. The filaments are then drawn and cooled, laid onto a moving conveyor belt and consolidated through any number of methods, including thermal bonding (heat and pressure), needlepunching, chemical bonding, or hydroentangling. Spunmelt composites are created in a similar way, but include multiple melt blown and spunbonded layers which are laid atop each other prior to consolidation.

Features and Benefits

Since the spunbonded and spunmelt composite processes yield continuous filament fabrics, the resultant nonwoven exhibits high strength in both the cross- and machine-direction, as well as resistance to abrasion. As the spunbonded technology is an integrated one-step process from resin extrusion to nonwoven fabric, the cost per unit weight is typically lower than other competing technologies. Spunmelt composites, because of the fine fiber melt blown layer(s), can act as a barrier (to repel liquids) while also maintaining a certain level of breathability.

Selected Market Applications

Spunbonded and spunmelt composite fabrics are used in hygiene, medical, fabric softener, filter media, furniture and bedding, automotive, geotextiles and roofing markets, to name a few.

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Melt Blown

Description

The melt blown process is similar to spunbonded in that it begins with resin, but is different in that shorter, very fine, discontinuous filaments are extruded but not oriented. The resin is heated and extruded through a die. Hot air is used to attenuate the extruded polymer to form the fine fibers that are essentially "blown" onto a moving conveyor in close proximity to the die.

Features and Benefits

The fine denier (small diameter) of the filaments results in a web that is highly suitable as a filter media, barrier fabric or high capacity absorbent.

Selected Market Applications

Applications for melt blown nonwovens include filtration media, barrier fabrics, sorbents and wipes.

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Carded

Description
The carded nonwovens process is textile-like process in which the raw material is staple fibers, which are separated and then carded, or "combed" into a web by passing through rotating cylinders covered by wires with teeth. Carded fabrics tend to have a predominantly uni-directional fiber orientation but some cards have sections that allow the fiber arrays to be randomized, which can increase the cross-directional strength of the web. The unbonded fibrous web is subsequently consolidated by a number of means – with heat and pressure from a calender, by adding chemical binders, by hydroentangling with water jets (spunlaced) or by processing it through a hot-air oven (thru-air bonded).

Features and Benefits
Since carding begins with staple fibers, one of the benefits is the ability to blend different fiber types together to produce a nonwoven. In addition, depending upon how many cards are used, multiple layers can be made to achieve different performance characteristics. Each of the consolidation processes noted above yields differing benefits. However, in comparison to resin-based processes, carding typically will offer improved loft and softness. Carded nonwovens tend to be relatively strong in the machine direction and relatively weak in the cross direction.

Selected Market Applications
Carded nonwovens have applications in major markets such as hygiene, wipes, apparel interlinings and filter media.

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Wet Laid

Description
The wet laid nonwovens process is the most similar to traditional paper-making in that it begins with a slurry, typically consisting of a high percentage of water, staple fibers and/or pulp-based raw materials. The slurry is collected on a screen, which can be a wire belt on an incline, a cylinder, or fed between two wire belts. The water is removed by squeezing the web between rolls, and dried in ovens.

Features and Benefits
Wet laid nonwovens are isotropic (equal machine and cross-directional strength), strong, highly uniform and can be quite absorbent with excellent wicking properties. Chemicals, binders and colors can be easily added in the process.

Selected Market Applications
Wet laid nonwovens are used for medical packs and gowns, filter media and apparel markets.

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Spunlaced or Hydroentangled

Description

Spunlaced, or hydroentangled nonwovens, involve the use of water jets to consolidate the web. Any web forming process can be used to create the web, typically made from pulp, staple or filament fibers and/or other raw materials. The web is then consolidated by applying water through fine, high pressure jets which cause the fibers to curl and entangle about each other. In a new process variant, spunbonded multi-component filaments are split into microdenier fibers with the fine water jets. The microdenier filaments are also entangled with the water jets.

Features and Benefits
The spunlaced process yields the most textile-like product of any of the current production processes – the nonwoven is strong, soft and pliable, can be dense or open and highly absorbent, depending upon the fibers or resins employed.

Selected Market Applications
Medical packs and gowns and wipes are two representative end markets for spunlaced nonwovens.

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Airlaid

Description
The airlaid process begins with a defibration system to open fluff pulp and may also include equipment to open and feed short cut staple fiber and dose superabsorbents or other powders. These materials are suspended in air within a forming system and deposited on a moving forming screen or rotating perforated cylinder. The randomly oriented airformed batt is bonded by applying latex binder and drying, thermally bonding thermoplastic staple fibers in the web, hydrogen or embossed bonding or a combination of these consolidation techniques.

Features and Benefits
Airlaid nonwovens are highly absorbent, lofty fabrics or composites that are relatively cost competitive with similar weight nonwovens because of their use of lower cost wood pulp.

Selected Market Applications
Wet and dry wipes and absorbent cores for hygiene products are two representative uses for airlaid nonwovens.

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Thermal Bonded

Description
Thermally bonding a web involves applying heat and pressure via a calendar to consolidate the web.

Features and Benefits
Thermal bonding can yield fabrics which have strength, aesthetic quality, density, loft and softness.

Selected Market Applications
Representative applications include hygiene nonwovens, apparel and filtration.

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Chemical or Resin Bonded

Description
Consolidating a web through chemical or resin bonding involves applying an adhesive resin (binder) to the web by dipping it in a bath, or spraying, foaming or printing the binder onto the web. The binder solution is removed by drying the web. Other terms used to describe chemical bonding include saturation bonding, gravure printing, screen printing, spray bonding and foam bonding.

Features and Benefits
The application of binders is relatively simple, and colors can easily be added to the chemical bonding process.

Selected Market Applications
Chemically bonded nonwovens typically are used for hygiene applications, wipes substrates, fabric softener sheets and apparel interlinings.

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Needlepunched

Description
Needlepunched nonwovens are consolidated by inserting barbed needles mechanically into the substrate, hooking tufts of fibers through it and entangling the fibers in the needlepunched areas. During this process, the web travels between two plates while it is pulled by draw rolls.

Features and Benefits
Needlepunched nonwovens are typically lofty and strong, and heavier than most other nonwovens products. They offer excellent capacity for holding particles and provide good cushioning.

Selected Market Applications
Needlepunched nonwovens are used in numerous markets including geotextiles, automotive, furniture and bedding, construction and filtration.

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Whether used in a wipe, a surgical gown or as substrates for artificial leather, **spunlaced** nonwoven materials are finding application in a broad range of end uses, which has helped propel the process into what some say is the fastest growing technology in the nonwovens spectrum. Also known as hydroentangling, the spunlacing process involves mechanically wrapping and knotting fibers in a web through the use of high velocity jets of water.

Currently, 110 spunlace plants are in production worldwide and additional lines are scheduled to start up around the world. Industry experts estimate that approximately 12% of nonwovens produced in the world are made through a **spunlaced** process.

"In the last two years, we have doubled our spunlacing output," said David Ferrar, general manager, BFF Nonwovens, Somerset, U.K. "This has been completely driven by demand and we are always able to fill the added capacity."

The growth in **spunlaced** materials has been led largely by the increased interest in disposable wiping products for household, personal care and industrial applications. While other applications certainly exist for **spunlaced** nonwoven fabrics, their textile-like feel, softness, durability and absence of chemical additives make them ideal for wiping applications. These benefits also make **spunlaced** nonwovens well suited for the medical market where barrier protection benefits need to be combined with softness and drapability.

While **spunlaced** nonwovens are ripe with benefits, manufacturers are still facing several challenges. For one, spunlacing lines use a great deal of energy so it is important to produce them in large volumes. As overcapacity continues to be somewhat of a problem in the spunlacing market, producers have had to lower the costs of these roll goods. "It has been turning from a sellers' market to a buyers' market despite the big growth of the wipes market," said Walter Hofmann, sales director, Jacob Holm, Soultz, France. "I think it should stay this way for the next two years and a lot of this will depend on what happens in the U.S. market."

Spunlacing equipment supplier Rieter Perfojet, Montbonnot, France, has tried to cut the cost of producing these materials with the introduction of its new machine, "Jetlace 3000." The machine was designed to reduce the energy required to entangle the fibers making it less expensive to operate than other spunlacing machines. "Producers want low costs because spunlacing technology is now huge in terms of volume compared to demand," said Bruno Roche, area sales manager. "This has driven down the costs of the finished material; therefore the costs of making the web needs to be reduced."

Furthermore, for the segment to continue its strong growth rate, manufacturers must develop innovative technologies to help **spunlaced** materials find a place in new application areas. One such market is the apparel market, which the nonwovens industry as a whole has coveted for decades. Because **spunlaced** nonwovens so closely resemble textiles, many manufacturers believe it will be the nonwoven technology most likely to take share from woven and knitted fabrics.

"The apparel market is definitely a possibility," said Carl Lukach, global business manager, "Sontara" for DuPont, Wilmington, DE. "That's the big dream of the next decade."

Spunlacing Wipes Up

For a long time, baby wipes were the main focus of producers targeting the wipes market. While baby wipes remain the largest category in the wipes market, they are being joined by new applications including personal care wipes, household cleaning wipes and industrial wipes. Every day it seems another new wiping product is hitting store shelves. In the U.S., all of the major consumer product giants—Procter & Gamble, Cincinnati, OH; Lever Brothers, London, U.K.; Reckitt Benckiser, Windsor Berkshire, U.K. and S.C. Johnson, Racine, WI—have launched wiping products and this trend does not appear to be letting up any time soon. Industry watchdogs claim the proliferation of the U.S. wipes market mimics activity already seen in Europe and Japan.

"In Japan, there is a wipe product for practically any application you can think of," said BFF's Mr. Ferrar. "It's to the point where there is practically one product to wipe your left shoe and another to wipe your right shoe. Europe also has a lot of wiping applications and so does the U.S., but I think it's still in its infancy."

While some wiping applications such as personal care products are more suited to air laid materials because they offer a great deal of softness, **spunlaced** materials are often the fabric of choice because of their durability. Still, industry insiders interviewed by Nonwovens Industry feel that air laid materials pose little threat to spunlacing. "Both the use of air laid and **spunlaced** fabrics in wiping applications will continue to increase," said Philippe Wigns, business director, BBA Nonwovens. "There will be a market for both strategies and differentiation in product concept and marketing strategies will further help

develop certain consumer markets for nonwoven fabrics."

Currently, the U.S. imports a great deal of **spunlaced** material from Europe but industry experts expect to see additional spunlacing lines coming onstream here in coming years. The challenge for these roll goods producers will be to convince Americans that spunlace-based wipes are worth the few pennies more they cost. Of course a big driver in the growth of the wipes market is convenience. Consumers have limited time and a premoistened wipe saves them time whether it is in cleaning the bathroom, removing make up or washing their cars. These wipes, however, must be effective and strong because consumers want to get their money's worth.

"**Spunlaced** nonwovens work well for wipes because they are soft, strong, easy to handle and feature good absorption," said Jacob Holm's Mr. Hofmann. "It has a more textile feel, like a towel, that consumers prefer." Mr. Hofmann predicted that companies will soon begin differentiating the structure of their wipes to stand apart from the competition. While now most wipe products are constructed into a plain white cloth material and differentiated only by their outer packaging, in the future companies will use different colors, printing options, embossing patterns and other design capabilities to make their wipes stand out. "It will follow the diaper market," he said. "In the beginning, everyone made the same product and later began adding bells and whistles like leg cuffs and design patterns. Wipe producers will do the same to differentiate their products from the others."

DuPont has focused its Sontara brand of **spunlaced** material more on the industrial area than the consumer segment. Credited with developing the spunlacing process more than 30 years ago, the company dabbles in baby, personal care and household cleaning wipes but has focused more on high tech areas such as wipes for the aerospace, cleanroom, automotive, automotive refinishing and printing industries. For instance, the company recently combined knowledge from its automotive surface coatings unit with its nonwovens technology to create an automotive surface preparation system containing five wipes. "We applied the science from an area the company knows a lot about—the surface coatings segment—to benefit our Sontara brand," said the company's Mr. Lukach.

Like DuPont, IMP Group, Padova, Italy, has been content to focus its spunlacing business on niche applications. Nearly 90% of the company's **spunlaced** output finds application in the artificial leather substrate market, according to Marcello Bozzo, product manager. The company entered this market because it saw great opportunity for **spunlaced** materials in the Italian shoe market and is now the European leader in artificial leather substrates. "We mainly produce viscose-based **spunlaced** nonwovens because they are able to absorb moisture and simulate real leather," he added.

Tech Craze

Many of the same features—good drapability, the absence of additives, effective barrier protection—that make **spunlaced** materials ideal for the wipes market also make them ideal for other areas including the medical and protective apparel markets. These features have also led some nonwovens manufacturers to envision a place for **spunlaced** nonwovens in the future of the garment industry, which could mean great things for the nonwovens industry as a whole.

Spunlace technology is being driven by a desire among manufacturers to compete with woven and knitted fabrics. One company making great strides in this area is Freudenberg Nonwovens, Weinheim, Germany, which launched "Evolon" last year. Boasting a versatile product range and vast end use capabilities, Evolon, which is being dubbed the first continuous microfiber **spunlaced** fabric, competes favorably with woven and knitted fabrics as well as with staple fiber nonwovens by offering higher strength to weight ratios. Manufactured through a proprietary process that combines filament spinning and web formation, Evolon offers good drapability, soft hand, high tensile strength, comfort properties and good launderability. Applications range from apparel, interlinings, rental laundry workware and automotive to carpet backing, sound insulation, footwear, luggage

and home furnishings.

Industry experts expect to see more innovations similar to Evolon appearing to reshape the spunlace market and, in effect, the nonwovens industry as a whole. "The ability to split fibers with high pressure to make subdenier fibers is receiving a lot of interest," said Don Gillespie, vice president of spunlacing machinery supplier Fleissner, Charlotte, NC. "This process gives materials a fine and soft texture."

Additionally, the formation of composite structures containing a **spunlaced** layer with a second layer made with another woven or nonwoven process is expected to boost the category into new application areas. "**Spunlaced** materials on their own can't really make a great deal of inroads into the clothing market unless they are part of a composite," BFF's Mr. Ferrar said. "We will be going after a share of the woven market by combining a woven with a **spunlaced** nonwoven." While Mr. Ferrar declined to comment on his company's specific plans for the apparel market, he did say the company would be making major announcements in upcoming months.

Besides coupling **spunlaced** materials with woven materials, manufacturers are examining the possibility of layering them with nonwovens made with other processes such as air laid and spunbond. "Spunlacing in combination with other technologies is the future of this market," Rieter Perfojet's Mr. Roche said. "Adding another technology can make **spunlaced** materials easier to produce while improving the qualities of the end product." Reiter Perfojet has already developed a combination spunbond, spunlace and air laid line that runs at extremely high speed.

In addition to composite structures, **spunlaced** manufacturers are seeking ways to develop a higher weight fabric through the **spunlaced** process. Created through the use of higher pressure water jets, these thicker fabrics compete directly with needlepunched nonwovens, according to Fleissner's Mr. Gillespie. Fleissner has already been able to process **spunlaced** fabrics with weights as high as 600 gpsm. Two reasons spunlacing is preferential to **needlepunching** are its quicker line speeds and its ability to keep the fibers from damage, Mr. Gillespie added.

While grabbing share away from competing nonwovens technologies as well as knitted and woven applications is necessary for growth to continue in the **spunlaced** market, the future in this category depends largely on the efforts of big name nonwoven end users which are, in turn, dictated by consumer demand. "The spunlace category should grow for a while," BFF's Mr. Ferrar said. "The challenge will be for the big national brands to create more innovative products." For instance, last year, P&G launched its "Swiffer" brand of antistatic dust clothes made of a scrim-reinforced spunlace material. This product opened up a whole new category for nonwovens in the household cleaning market.

What other categories **spunlaced** nonwovens find their way into remains to be seen. Whether it be the above mentioned apparel industry or another application that no one has yet dreamed up, there is no doubt that this textile-like application has the power to help the nonwovens industry move into previously untapped markets, take share from woven and knitted materials and continue the growth it has seen in recent years.